

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims

Claim 1. (Original) A process for partially oxidizing propene to acrylic acid in the gas phase under heterogeneous catalysis by conducting a starting reaction gas mixture 1 which comprises propene, molecular oxygen and at least one inert gas, and contains the molecular oxygen and the propene in a molar $O_2:C_3H_6$ ratio of ≥ 1 in a first reaction stage over a fixed catalyst bed 1 which is arranged in two spatially successive reaction zones A, B, the temperature of reaction zone A being a temperature in the range from 290 to 380° C and the temperature of reaction zone B likewise being a temperature in the range from 290 to 380° C, and whose active composition is at least one multimetal oxide comprising the elements Mo, Fe and Bi, in such a way that reaction zone A extends to a propene conversion of from 40 to 80 mol % and the propene conversion on single pass through the fixed catalyst bed 1 is ≥ 90 mol % and the accompanying selectivity of acrolein formation and also of acrylic acid by-production taken together is ≥ 90 mol %, the temperature of the product gas mixture leaving the first reaction stage is optionally reduced by cooling and molecular oxygen and/or inert gas are optionally added to the product gas mixture, and then the product gas mixture, as a starting reaction gas mixture 2 comprising acrolein, molecular oxygen and at least one inert gas and containing the molecular oxygen and the acrolein in a molar $O_2:C_3H_4O$ ratio of ≥ 0.5 , is conducted in a second reaction stage over a fixed catalyst bed 2 which is arranged in two spatially successive reaction zones C, D, the temperature of reaction zone C being a temperature in the range from 230 to 320° C and the temperature of

reaction zone D likewise being a temperature in the range from 230 to 320° C, and whose active composition is at least one multimetal oxide comprising the elements Mo and V, in such a way that reaction zone C extends to an acrolein conversion of from 45 to 85 mol % and the acrolein conversion on single pass through the fixed catalyst bed 2 is ≥ 90 mol % and the selectivity of acrylic acid formation assessed over all reaction zones, based on converted propene, is ≥ 80 mol %, the sequence in time in which the reaction gas mixture flows through the reaction zones corresponding to the alphabetic sequence of the reaction zones, wherein

- a) the hourly space velocity of the propene contained in the starting reaction gas mixture 1 on the fixed catalyst bed 1 is < 160 l (STP) of propene/l of fixed catalyst bed 1 \cdot h and ≥ 90 l (STP) of propene/l of fixed catalyst bed 1 \cdot h;
- b) the volume-specific activity of the fixed catalyst bed 1 is either constant or increases at least once in the flow direction of the reaction gas mixture over the fixed bed catalyst bed 1;
- c) the difference $T^{\max A} - T^{\max B}$, formed from the highest temperature $T^{\max A}$ which the reaction gas mixture has within reaction zone A and the highest temperature $T^{\max B}$ which the reaction gas mixture has within reaction zone B is $\geq 0^\circ$ C;
- d) the hourly space velocity of the acrolein contained in the starting reaction gas mixture 2 on the fixed catalyst bed 2 is < 145 l (STP) of acrolein/l of fixed catalyst bed 2 \cdot h and ≥ 70 l (STP) of acrolein/l of fixed catalyst bed 2 \cdot h;

- e) the volume-specific activity of the fixed catalyst bed 2 increases at least once in the flow direction of the reaction gas mixture over the fixed bed catalyst bed 2; and
- f) the difference $T^{\max C} - T^{\max D}$, formed from the highest temperature $T^{\max C}$ which the reaction gas mixture has within reaction zone C and the highest temperature $T^{\max D}$ which the reaction gas mixture has within reaction zone D, is $\geq 0^\circ \text{C}$.

Claim 2. (Original) A process as claimed in claim 1, wherein the difference $T^{\max A} - T^{\max B}$ is $\geq 3^\circ \text{C}$ and $\leq 70^\circ \text{C}$.

Claim 3. (Original) A process as claimed in claim 1, wherein the difference $T^{\max A} - T^{\max B}$ is $\geq 20^\circ \text{C}$ and $\leq 60^\circ \text{C}$.

Claim 4. (Currently Amended) A process as claimed in ~~any of claims~~ claim 1 to 3, wherein the difference $T^{\max C} - T^{\max D}$ is $\geq 3^\circ \text{C}$ and $\leq 60^\circ \text{C}$.

Claim 5. (Currently Amended) A process as claimed in ~~any of claims~~ claim 1 to 3, wherein the difference $T^{\max C} - T^{\max D}$ is $\geq 3^\circ \text{C}$ and $\leq 40^\circ \text{C}$.

Claim 6. (Currently Amended) A process as claimed in ~~any of claims~~ claim 1 to 5, wherein the hourly space velocity of the propene contained in the starting gas mixture on the fixed catalyst bed 1 is $\geq 100 \text{ l (STP) or propene/l} \cdot \text{h}$ and $\leq 150 \text{ l (STP) or propene/l} \cdot \text{h}$.

Claim 7. (Currently Amended) A process as claimed in ~~any of claims~~ claim 1 to 5, wherein the hourly space velocity of the propene contained in the starting gas mixture on the fixed catalyst bed 1 is ≥ 110 l (STP) or propene/l • h and ≤ 145 l (STP) or propene/l • h.

Claim 8. (Currently Amended) A process as claimed in ~~any of claims~~ claim 1 to 7, wherein the difference $T_B - T_A$ between the temperature of reaction zone B, T_B , and the temperature of reaction zone A, T_A , is $\geq -10^\circ \text{C}$ and $\leq 0^\circ \text{C}$.

Claim 9. (Currently Amended) A process as claimed in ~~any of claims~~ claim 1 to 8, wherein the difference $T_C - T_D$ between the temperature of reaction zone D, T_D , and the temperature of reaction zone C, T_C , is $\geq -10^\circ \text{C}$ and $\leq 0^\circ \text{C}$.

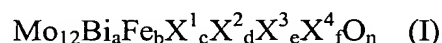
Claim 10. (Currently Amended) A process as claimed in ~~any of claims~~ claim 1 to 9, wherein the temperature of reaction zone A is from 305 to 365°C .

Claim 11. (Currently Amended) A process as claimed in ~~any of claims~~ claim 1 to 9, wherein the temperature of reaction zone A is from 310 to 340°C .

Claim 12. (Currently Amended) A process as claimed in ~~any of claims~~ claim 1 to 11, wherein the temperature of reaction zone C is from 250 to 300°C .

Claim 13. (Currently Amended) A process as claimed in ~~any of claims~~ claim 1 to 12, wherein the temperature of reaction zone C is from 260 to 280°C .

Claim 14. (Currently Amended) A process as claimed in ~~any of claims claim 1 to 13~~, wherein the active composition of the fixed catalyst bed 1 is at least one multimetal oxide active composition of the general formula I



where

X^1 = nickel and/or cobalt,

X^2 = thallium, an alkali metal and/or an alkaline earth metal,

X^3 = zinc, phosphorus, arsenic, boron, antimony, tin, cerium, lead and/or tungsten,

X^4 = silicon, aluminum, titanium and/or zirconium,

a = from 0.5 to 5,

b = from 0.01 to 5,

c = from 0 to 10,

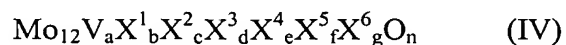
d = from 0 to 2,

e = from 0 to 8,

f = from 0 to 10 and

n = a number which is determined by the valency and frequency of the elements other than oxygen in I.

Claim 15. (Currently Amended) A process as claimed in ~~any of claims claim 1 to 14~~, wherein the active composition of the fixed catalyst bed 2 is at least one multimetal oxide active composition of the general formula IV



where the variables are defined as follows:

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X^1 = W, Nb, Ta, Cr and/or Ce,

X^2 = Cu, Ni, Co, Fe, Mn and/or Zn,

X^3 = Sb and/or Bi,

X^4 = one or more alkali metals,

X^5 = one or more alkaline earth metals,

X^6 = Si, Al, Ti and/or Zr,

a = from 1 to 6,

b = from 0.2 to 4,

c = from 0.5 to 18,

d = from 0 to 40,

e = from 0 to 2,

f = from 0 to 4,

g = from 0 to 40 and

n = a number which is determined by the valency and frequency of the elements other than oxygen in IV.